National Transportation Safety Board
Aviation Accident Final Report

Location:	Ketchikan, AK	**Accident Number:**	ANC07MA083
Date & Time:	08/16/2007, 1730 AKD	**Registration:**	N345KA
Aircraft:	de Havilland DHC-2	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	5 Fatal, 4 Serious
Flight Conducted Under:	Part 135: Air Taxi & Commuter - Non-scheduled - Sightseeing		

Analysis

The float-equipped airplane was departing from a remote bay 20 miles north of Ketchikan, Alaska, to return air taxi passengers to Ketchikan after a ground tour. The accident pilot, who reported that he had 17,000 flight hours and 7,000 hours in the make and model of the accident airplane, said that southeasterly winds had begun to increase while he was waiting at the bay for the passengers to return from the tour. He said that, unlike when he had landed about 2.5 hours earlier, it was no longer “nice and calm” when the passengers returned. The pilot noticed choppy waves in parts of a nearby cove.

To avoid some of the wind and waves, the pilot elected to take off toward the interior of the bay, in the direction of rising terrain. The pilot said that he had never taken off in that direction before. The pilot also said that he had intended to make a shallow, right-climbing turn toward the mouth of the bay and away from the terrain, but shortly after takeoff, he saw numerous choppy waves concentrated along his proposed departure flightpath, which he said indicated to him that strong winds were likely along that path. The pilot decided to change his plan and continue flying straight temporarily, away from the waves, and to make a left, 180-degree turn inside the bay, which was surrounded by high terrain. The pilot indicated that when the turn was initiated, the airplane was about 400 feet above the water, and he did not recall the indicated airspeed. The attempted 180-degree turn was within the airplane’s performance capabilities but placed it closer to rising terrain.

While attempting this turn, the pilot encountered a downdraft, was unable to climb above the terrain, and stalled the airplane about 60 feet above the ground. The downdraft likely made it more difficult to avoid descending into the rising terrain. A weather study by the National Transportation Safety Board confirmed that there was a gust front in the area and an abrupt wind change about the time of the accident. Pilots flying nearby also reported low-level windshear, strong winds, and turbulence.

No mechanical anomalies were discovered during postaccident inspections by the Safety Board.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: An inadvertent aerodynamic stall resulting from the pilot's poor decision-making and inadequate planning and execution when he took off toward nearby rising terrain, in strong winds, under circumstances where his options for maneuvering were severely limited and where his safety margin was, thus, insufficient.

Findings

Occurrence #1: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: MANEUVERING

Findings
1. (F) TERRAIN CONDITION - RISING
2. (C) AIRSPEED(VS) - NOT MAINTAINED - PILOT IN COMMAND
3. (F) WEATHER CONDITION - HIGH WIND
4. (F) STALL - INADVERTENT - PILOT IN COMMAND
5. (F) WEATHER CONDITION - DOWNDRAFT
6. (C) WEATHER EVALUATION - INADEQUATE - PILOT IN COMMAND

Occurrence #2: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: DESCENT - UNCONTROLLED

Findings
7. OBJECT - TREE(S)

Factual Information

HISTORY OF FLIGHT

On August 16, 2007, about 1730 Alaska daylight time, a float-equipped de Havilland DHC-2 (Beaver) airplane, N345KA, was destroyed by impact and a postimpact fire when it collided with tree-covered terrain, about 20 miles north of Ketchikan, Alaska. The airplane was being operated as a visual flight rules (VFR) sightseeing flight under the provisions of 14 Code of Federal Regulations (CFR) Part 135, when the accident occurred. The airplane was owned and operated by Seawind Aviation, Inc., Ketchikan, Alaska. Of the nine people aboard, the airline transport pilot and three passengers sustained serious injuries, and five passengers died at the scene. A sixth passenger died of her injuries 48 days after the accident. Visual meteorological conditions prevailed, and company flight following procedures were in effect. At the time of the accident, the flight was returning to the operator's base at the Ketchikan Harbor Seaplane Base, Ketchikan.

The flight was a sightseeing flight for cruise ship passengers. The passenger's cruise ship was docked in Ketchikan, and the accident flight was the last flight of the day following a bear viewing tour in an area known as Traitor's Cove.

During an initial emergency room interview with an Alaska State Trooper on August 16, a passenger stated that at the completion of the 2-hour long bear-viewing tour, the group retuned to the airplane for the flight to Ketchikan. The passenger reported strong and gusty winds prior to beginning the takeoff run. She said that the airplane started its takeoff run directly into the strong winds, and shortly after becoming airborne, it made a steep turn to the left. The passenger indicated that as the airplane turned left, it abruptly descended, and collided with a tall stand of trees along the shoreline of the bay. During the impact, the right wing was severed, and the airplane's fuselage came to rest on its right side. The passenger said that a postaccident fire ensued about 30 seconds after the collision, which consumed the airplane's cabin area and fuselage.

Pilots flying in the area about the time of the accident reported strong southeasterly winds, ranging between 30 and 40 knots, with significant downdraft activity.

As a result of the accident, the pilot sustained serious burn injuries, and was flown from Ketchikan by air ambulance to a hospital in Seattle, Washington. On September 5 and 6, 2007, once the pilot's condition had improved, the National Transportation Safety Board's (NTSB) operations group chairman, and an NTSB human factors investigator, interviewed the pilot in his hospital room.

The pilot reported the arrival at Traitors Cove was normal, and that he waited at the airplane while the passengers took the bear-viewing ground tour. He noted that the weather was beautiful, with hardly any wind, but that while he was waiting for his passengers, the weather changed. He said that he could tell that the wind at higher altitudes was getting blustery, and could tell the direction of the wind, but not the magnitude. There was no rain or convective activity, and the only change he noted was that it "just wasn't as nice and flat calm anymore."

He said he took off into the southeasterly wind, with the intent of making a shallow, right climbing turn toward the mouth of the bay, away from rising terrain. However, during the takeoff run, he indicated that there were numerous 3-foot choppy waves concentrated along his proposed departure flight path, and he decided to continue straight ahead, toward the mouth

of the bay, and then make a left, 180-degree turn inside the bay. He said he had never seen the wind "blowing that hard out of the lake like that."

About 400 feet agl, and about 90 degrees into his intended 180-degree left turn, the pilot said, in part, "the bottom started to fall out fast." He indicated that the left bank was "not much, less than 30, 25 degrees." He said that he added engine power and more flaps while holding back elevator, but the airplane continued to descend. He said that the airplane stalled about 60 feet above the ground, just before contacting the tops of the trees. The airplane collided with trees and descended to the ground. The engine was torn off the fuselage, and a fire began immediately near the front of the airplane.

The pilot stated that there were no preaccident mechanical anomalies with the accident airplane.

PERSONNEL INFORMATION

Pilot Information

The pilot held an airline transport pilot certificate with airplane multiengine land and sea ratings. In addition, he held commercial pilot privileges with airplane single-engine land and sea ratings. His most recent second-class medical certificate was issued March 8, 2007, and contained the limitation that he must wear correcting lenses.

He reported that his flight experience was about 17,000 total flight hours, of which about 7,000 hours were in the accident airplane make and model. In the 30 days before the accident, he flew about 180 hours. His flight time in the previous 90 days was 467 hours, and about 580 hours in the previous year. His most recent CFR Part 135.293 check ride was on April 17, 2007. A Federal Aviation Administration (FAA) operations inspector from the Juneau Flight Standards District Office (FSDO) administered the check ride in the accident airplane.

Flight and duty records for the pilot revealed that his annual/quarterly record keeping began in January 2007. From January 2007, through March 2007, the pilot flew a total of 11 days, with the remainder as days off. From April 2007, through June 2007, the pilot flew 57 days, and had 35 days off. Beginning on May 12, he flew every day for the next 63 days, until his most recent day off from flying on July 14. He then flew every day for the next 33 days until the accident.

Company Information

The pilot was the owner of the company, and held a Part 135 single-pilot operator air taxi certificate. He was responsible for operational control of the company's only airplane. The pilot's wife assisted him in the company's day-to-day business needs.

As a single-pilot operator, the company was not required to have an operating manual, a formal training program, a director of maintenance, director of operations, or a chief pilot.

The company operations specifications, issued by the FAA's Juneau FSDO, specified that all weather reports and forecasts would be obtained from the National Weather Service (NWS), a source approved by the NWS, or other sources approved by the FAA. For VFR operations, the pilot's own observations, or those of another competent observer, could be used when approved sources were not available.

AIRPLANE INFORMATION

The airplane was equipped with a Pratt & Whitney R-985 radial engine that was rated at 450 horsepower. Originally, the airplane's maximum gross weight was 5,090 pounds, but it had been modified to 5,500 pounds.

The airplane was equipped with Edo 4930 floats.

The airplane was not equipped with a cockpit voice recorder, or a flight data recorder, nor was it required to be.

Maintenance records revealed that the last recorded inspection event of the engine and airframe was a 100-hour inspection, completed on August 14, 2007, 2 days before the accident. At that time, the airplane had a total 22,409 service hours, and the engine had 1,070 service hours since the last major overhaul.

The most recent annual inspection of the engine and airframe was on March 9, 2007, at which the airplane had 21,974 service hours, and the engine had 635 service hours since a major overhaul.

An engine overhaul was done by Tulsa Aircraft Engines, Inc., on October 17, 2005. The engine was installed on the accident airplane on March 23, 2006, and it remained there until the accident.

The airplane had a stall warning system, which incorporated a horn and a red light mounted on the instrument panel that warned the pilot of an approaching stall. A sensing vane on the leading edge of the left wing activated the warning horn and light at the onset of a stall.

According to the performance information section of the airplane's FAA approved flight manual, the stall speed for a DHC-2 airplane configured with the recommended takeoff flap setting of 35 degrees, operating at 4,658 pounds (the estimated gross weight of the airplane at the time of the accident), ranges between 58 and 81 miles per hour, depending on bank angle.

The airplane was equipped with various FAA-approved modifications since its original manufacture in 1959. These modifications were incorporated using FAA-approved supplemental type certificates (STC).

Sealand Aviation Jump Seats, STC SA01380NY

The airplane was originally equipped with seven seats that incorporated two front seats, three seats across at the rear doors, and a two-seat, fold-down hammock style seat attached to the aft fuselage bulkhead. At the time of the accident, the airplane was equipped with a Sealand Aviation jump seat kit, which adds two additional seats to the aft bulkhead, allowing a total of nine seats. Flight Manual Supplement FMS 7967-3 authorized the use of up to nine seats. The most aft seats had two seating positions, with a collective weight limit of 195 pounds. The aft seat, if occupied by two persons, required that the occupants sit side-by-side. The aft seat, if occupied by one person, required that the occupant sit in the middle of the seat.

Sealand Aviation Ltd., Baggage Extension, STC SA00094NY

This modification was a baggage area extension kit, which accommodated the installation of the two additional jumps seats referenced above.

Kenmore Air Harbor, Edo Floats, STC SA1913WE

Provided for the installation of EDO 679-4930 floats.

Kenmore Air Harbor Inc., Sea Fins, STC SA456NW

This modification provided for the installation of seaplane fins. These were small vertical stabilizers installed on the upper and lower surfaces at each end of the left and right horizontal stabilizer.

Viking Air Ltd., Gross Weight Increase, STC SA00299NY

This modification allowed DHC-2 operators to increase the gross weight from 5,090 pounds, to 5,500 pounds with EDO 679-4930 floats installed. The STC required the installation of a stall warning system consisting of a stall warning horn, and stall warning light on the instrument panel.

An initial review of the gross weight increase STC revealed that the ventral fin on the underside of the empennage was considered optional when the Kenmore Air Harbor seaplane fins were installed, and a ventral fin was not installed on the accident airplane.

On March 27, 2008, a representative from Viking Air Ltd., confirmed that a ventral fin on the underside of the empennage is considered "optional" when the Kenmore Air Harbor seaplane fins are installed. He noted that the ventral fin provides additional lateral stability when operating at low airspeeds, and when the airplane is operated at a gross weight between 5,090 and 5,500 pounds, or within the provisions of the gross weight increase STC.

On June 12, 2008, a Viking Air Ltd. representative reported that a detailed review of the engineering data surrounding STC SA00299NY revealed that the ventral fin was in fact required when the 5,500 pound gross weight modification was in use, with Edo 4930 floats installed. He noted that the language in revision number 4 of the installation instructions, issued on September 15, 2004, was misleading, and implied that the ventral fin on the underside of the empennage was not required, but optional. He noted that Viking Air Ltd. is correcting the language for the installation of the ventral fin.

In a letter to the NTSB dated June 20, 2008, a Viking Air Ltd. representative noted that since the accident airplane was operating below 5,090 pounds, and within the airplane's normal gross weight envelope, no adverse flight characteristics would have been encountered during the accident flight with the absence of the ventral fin.

A senior aeronautical engineer from the FAA's Anchorage Aircraft Certification Office (ACO) reported that he reviewed STC approvals for de Havilland DHC-2 airplanes equipped with EDO 4930 floats and Kenmore seaplane fins, and concurred with Viking Air Ltd. findings.

METEOROLOGICAL INFORMATION

The closest weather reporting facility was the Ketchikan International Airport, 20 miles south of the accident site. About 23 minutes after the accident, at 1753, a weather observation from the Ketchikan Airport was reporting, in part: Wind, 140 degrees (true) at 17 knots, gusting to 31 knots; visibility, 10 statute miles; clouds and sky condition, few at 1,700 feet, 4,500 feet scattered, 11,000 feet scattered; temperature, 63 degrees F; dew point, 54 degrees F; altimeter, 29.86 inches Hg. Remarks; peak wind 140 degrees at 30 knots occurred at 1752, blowing dust east at the end of the runway, Harbor wind, 120 degrees at 14 knots, gusting to 20 knots.

After the accident, a pilot that departed from the same area as the accident airplane, reported strong gusty winds, estimated to be 35 to 40 knots, from the southeast. She said that she took

off crosswind, toward the outlet of Margaret Bay, and indicated that she used that strategy because it was "too scary," and she was "too much of a chicken" to do a departure path toward the head of the bay, which was the accident airplane's departure route.

Another pilot that responded to Traitors Cove to assist with evacuation of the accident airplane's occupants reported that when he arrived, the winds in the cove were from the southeast about 20 knots, with gusts to 25 knots.

A senior NTSB meteorologist did a comprehensive study of the weather conditions around the accident site, revealing a strong marine layer inversion and an abrupt wind change associated with the passage of a thunderstorm gust. The study disclosed that the forecast for the Ketchikan area included increasing instabilities over the region that were expected to produce rain showers and isolated afternoon thunderstorms, with the threat of small hail and strong gusty winds, which is an uncommon weather event for the area.

The NTSB meteorologist reviewed archived satellite imagery, captured about the time of the accident, which revealed evidence of a gust front traveling northward, and towards the accident site. He reported that a review of surface observations from the Ketchikan Airport noted a sudden increase in southeasterly winds, with a pressure jump, coupled with a 10-degree temperature drop, which is consistent with a gust front.

Reports from other pilots flying in the surrounding area, reported encountering low-level wind shear, strong gusty winds, and severe turbulence at lower altitudes. About 1759, the pilot of de Havilland DHC-3 airplane reported winds from 120 degrees at 30 knots, with peak gusts to 40 knots, about 15 miles west of Ketchikan.

The NTSB meteorologist also noted that historically, thunderstorms are not normal events in Alaska, with an average of only 1.10 thunderstorm days a year reported in the Ketchikan area.

A copy of the meteorologist's report is included in the public docket of this accident.

COMMUNICATIONS

After the airplane departed Ketchikan, there were no reports of communications with the pilot.

WRECKAGE AND IMPACT INFORMATION

Two investigators from the National Transportation Safety Board's (NTSB) Alaska Regional Office traveled to the accident site and examined the airplane wreckage on August 17 and 18.

All of the airplane's major components were found at the main wreckage site. A path of wreckage debris, from an area of broken trees to the wreckage point of rest, was on a magnetic heading of 350 degrees. (All heading/bearings noted in this report are oriented toward magnetic north.)

The airplane collided with trees along the shoreline, and continued inland into an area of heavily wooded rolling terrain. Several trees were broken and toppled at the wreckage site. With the exception of separated portions of the airframe, and the airplane's vertical stabilizer, a postcrash fire incinerated the airplane.

The first piece of airplane wreckage discovered along the debris path was the severed right wing, which was not fire damaged. The entire right wing separated at the fuselage wing attachment fittings. The leading edge of the wing had significant crush damage. The right

aileron was damaged and torn along the inboard end, but remained attached to the wing segment. The right flap was torn from its attachment points, but was found adjacent to, and within the wreckage path. The upper portion of the right wing lift strut remained attached to the wing, and the lower strut to fuselage fitting was broken.

The main portion of the airplane wreckage was about 75 feet inland from the shoreline, and came to rest on its right side, with the nose of the airplane on a 340-degree heading. The postcrash fire incinerated the entire cabin area, which included the instrument panel and all annunciator panels. Due to the extensive fire damage, the flight controls could not be moved by their respective control mechanisms.

The empennage, forward of the horizontal stabilizer attach points, was extensively fire damaged, but it remained attached to the burned main fuselage. The entire horizontal stabilizer and elevator assembly was torn from the fuselage, just forward of the vertical stabilizer attach points. The elevator remained attached to the stabilizers. The horizontal stabilizer and elevator assembly was located on the shoreline, adjacent to the initial impact point, which was partially submerged in water at high tide.

The propeller hub remained attached to the crankshaft flange. All three propeller blades were loose in the propeller hub, but they remained attached to the propeller hub assembly. The three propeller blades displayed multiple leading edge gouges, substantial torsional "S" twisting, and chordwise scratching.

The engine assembly was torn from the airplane's firewall, and was found about 3 feet from the main wreckage position. The engine sustained substantial impact damage to the front and underside portions, but sustained relatively minor fire damage, which was limited to the aft portion of the engine. The exhaust tubes were crushed upward, and the folded edges of the exhaust tubes did not exhibit any cracking or bending.

The airplane's fire damaged left wing was found adjacent to the main fuselage. About 3 feet of the inboard portion of the left wing was destroyed by fire. The left wing's outboard portions of the leading edge had significant crush damage. The left aileron and flap remained attached. The upper portion of the left wing lift strut remained attached to the wing, and the lower strut to fuselage fitting was fire damaged.

The airplane's flight control system cable continuity was established to the point of impact and fire related damage.

MEDICAL AND PATHOLOGICAL INFORMATION

No postmortem examination of the deceased passengers was accomplished, nor is it required in the State of Alaska.

The FAA's Civil Aeromedical Institute (CAMI) conducted a toxicological examination of urine samples collected from the pilot on September 27, 2007. The examination revealed no ethanol. Morphine, promethanine, and lidocaine were detected in the pilot's urine, which are drugs used in emergency treatment of traumatic injuries.

FIRE

A postaccident fire destroyed the airplane's main cabin and fuselage.

SURVIVAL ASPECTS

Following the crash, one of the four passengers that survived the accident reported that just after the accident, she remembered unbuckling her seatbelt, then pulling her 3-year old granddaughter out of the burning airplane as she exited herself. She was unable to remember just how she exited the airplane, but recalled having to crawl on her hands and knees since her hips had been broken during the impact.

The 3-year old granddaughter survived after being pulled from the burning wreckage by her grandmother, but died 48 days after the accident. The cause of death was attributed to the burns she received.

An NTSB senior survival factors engineer completed a Survival report of the accident. A copy of that report is included in the public docket of this accident.

TESTS AND RESEARCH

On September 19, 2007, at the direction and under the supervision of the NTSB IIC, an engine teardown and inspection was accomplished at Aero Engines, Inc., Los Angeles, California. The engine inspection revealed no preaccident mechanical anomalies.

WRECKAGE RELEASE

The Safety Board released the wreckage, located at the accident site, to the owner's insurance representative on August 19, 2007. The Safety Board retained the engine until September 19, 2007, when it was also released to the owner's insurance representative.

Pilot Information

Certificate:		**Age:**	44, Male
Airplane Rating(s):	Multi-engine Land; Multi-engine Sea; Single-engine Land; Single-engine Sea	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With Waivers/Limitations	**Last FAA Medical Exam:**	03/01/2007
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	04/01/2007
Flight Time:	17000 hours (Total, all aircraft), 7000 hours (Total, this make and model), 467 hours (Last 90 days, all aircraft), 180 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	de Havilland	**Registration:**	N345KA
Model/Series:	DHC-2	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	1306
Landing Gear Type:	Float	**Seats:**	9
Date/Type of Last Inspection:	08/01/2007, 100 Hour	**Certified Max Gross Wt.:**	5500 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	22409 Hours as of last inspection	**Engine Manufacturer:**	Pratt & Whitney
ELT:	Installed, not activated	**Engine Model/Series:**	R-985
Registered Owner:	Seawind Aviation, Inc.	**Rated Power:**	450 hp
Operator:	Seawind Aviation, Inc.	**Operating Certificate(s) Held:**	On-demand Air Taxi (135)
Operator Does Business As:		**Operator Designator Code:**	K5WA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	KTN, 88 ft msl	**Distance from Accident Site:**	20 Nautical Miles
Observation Time:	1753 ADT	**Direction from Accident Site:**	180°
Lowest Cloud Condition:	Few / 1700 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	17 knots / 31 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	140°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.86 inches Hg	**Temperature/Dew Point:**	17°C / 12°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	KETCHIKAN, AK	**Type of Flight Plan Filed:**	Company VFR
Destination:	Ketchikan, AK (5KE)	**Type of Clearance:**	None
Departure Time:	1730 ADT	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Destroyed
Passenger Injuries:	5 Fatal, 3 Serious	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	5 Fatal, 4 Serious	**Latitude, Longitude:**	55.700000, -131.633333

Administrative Information

Investigator In Charge (IIC):	Clinton O Johnson	**Report Date:**	12/09/2008
Additional Participating Persons:	Christine K Soucy; Federal Aviation Administration; Washington, DC George Gee; Viking Air Limited; Sidney, BC, Scott Erickson; NTSB Operations Group Chairman; Anchorage, AK Cynthia L Keegan; NTSB Survival Factors Engineer; Washington, DC Donald E Eick; NTSB Senior Meteorologist; Wahington, DC William J Bramble, Jr., Ph.D.; NTSB Aviation Human Performance Investigator; Washington, DC		
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Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		